CLAIMS

What is claimed is:

1. A flattened tube heat exchanger, the heat exchanger comprising:

a flattened tube (22) having first (28) and second (30) ends with a length therebetween and opposite first (34) and second (36) heat transfer surfaces that extend from the first end to the second end, the tube being shaped into a predetermined configuration with portions of the heat transfer surfaces being adjacent to other portions of the heat transfer surfaces and being spaced apart so that a space exists between each of the adjacent portions of the heat transfer surfaces, and the tube having at least one passageway (38) that extends through the tube from the first end to the second end so that a fluid can pass through the tube;

at least one heat transfer fin (24) having first and second ends, the first end of the at least one heat transfer fin being conductively attached to one of the first (34) or second (36) heat transfer surfaces and extending along a portion of the length of the tube that includes adjacent portions of the heat transfer surfaces, and a portion of the second end of the at least one heat transfer fin extending into at least one of the spaces between adjacent portions of the heat transfer surfaces; and

first (26) and second (26) manifolds attached to and in fluid communication with the respective first (28) and second (30) ends of the tube so that a fluid can pass between the first and second manifolds via the at least one passageway.

2. The heat exchanger of claim 1, wherein:

the portion of the second end of the at least one heat transfer fin extends into at least one of the spaces between adjacent portions of the heat transfer surfaces without contacting the adjacent portion of the heat transfer surface.

3. The heat exchanger of claim 1, wherein:

the at least one heat transfer fin extends along the entire length of the tube.

4. The heat exchanger of claim 1, wherein:

the at least one heat transfer fin is one of a plurality of heat transfer fins; and

a portion of the second end of said at least one heat transfer fin of the plurality of heat transfer fins extends into at least one of the spaces between adjacent portions of the heat transfer surfaces.

5. The heat exchanger of claim 4, wherein:

at least one heat transfer fin of the plurality of heat transfer fins is conductively attached to the first heat transfer surface; and

a different at least one heat transfer fin of the plurality of heat transfer fins is conductively attached to the second heat transfer surface.

6. The heat exchanger of claim 5, wherein:

the at least one heat transfer fin of the plurality of heat transfer fins that is attached to the first heat transfer surface extends along the entire length of the tube.

7. The heat exchanger of claim 6, wherein:

the different at least one heat transfer fin of the plurality of heat transfer fins that is attached to the second heat transfer surface extends along the entire length of the tube.

8. The heat exchanger of claim 1, wherein:

the at least one passageway is one of a plurality of passageways.

9. The heat exchanger of claim 8, wherein:

each passageway of the plurality of passageways are hydraulically parallel.

10. The heat exchanger of claim 1, wherein:

the at least one heat transfer fin is a corrugated heat transfer fin.

11. The heat exchanger of claim 1, wherein:

the tube is a continuous tube from the first end to the second end.

12. A flattened tube heat exchanger, the heat exchanger comprising:

a flattened tube having first and second ends with a length therebetween and opposite first and second heat transfer surfaces that extend from the first end to the second end, the tube having at least one passageway that extends through the tube from the first end to the second end so that a fluid can pass through the tube, and the tube being coiled along the length so that the first and second heat transfer surfaces are radially opposite and radially adjacent heat transfer surfaces are spaced apart with a space existing between the radially adjacent heat transfer surfaces;

at least one heat transfer fin having first and second ends, the first end of the at least one heat transfer fin being conductively attached to one of the first or second heat transfer surfaces and extending along a portion of the length of the tube that includes radially adjacent heat transfer surfaces, and a portion of the second end of the at least one heat transfer fin extending into the space between the radially adjacent heat transfer surfaces; and

first and second manifolds attached to and in fluid communication with the respective first and second ends of the tube so that a fluid can pass between the first and second manifolds via the at least one passageway.

13. The heat exchanger of claim 12, wherein:

the portion of the second end of the at least one heat transfer fin extends into the space between the radially adjacent heat transfer surfaces without contacting the radially adjacent heat transfer surface.

14. The heat exchanger of claim 12, wherein:

the tube is coiled so that the tube has alternating straight portions and curved portions along the length.

15. The heat exchanger of claim 14, wherein:

the curved portions are 90 degree curves.

16. The heat exchanger of claim 12, wherein:

the at least one heat transfer fin extends along the entire length of the tube.

17. The heat exchanger of claim 12, wherein:

the at least one heat transfer fin is one of a plurality of heat transfer fins; and

a portion of the second end of at least one heat transfer fin of the plurality of heat transfer fins extends into the space between the radially adjacent heat transfer surfaces.

18. The heat exchanger of claim 17, wherein:

at least one heat transfer fin of the plurality of heat transfer fins is conductively attached to the first heat transfer surface; and

a different at least one heat transfer fin of the plurality of heat transfer fins is conductively attached to the second heat transfer surface.

19. The heat exchanger of claim 18, wherein:

the at least one heat transfer fin of the plurality of heat transfer fins that is attached to the first heat transfer surface extends along the entire length of the tube.

20. The heat exchanger of claim 19, wherein:

the different at least one heat transfer fin of the plurality of heat transfer fins that is attached to the second heat transfer surface extends along the entire length of the tube.

21. The heat exchanger of claim 12, wherein:

the at least one passageway is one of a plurality of passageways.

22. The heat exchanger of claim 21, wherein:

each passageway of the plurality of passageways are hydraulically parallel.

23. The heat exchanger of claim 12, wherein:

the at least one heat transfer fin is a corrugated heat transfer fin.

24. The heat exchanger of claim 12, wherein:

the tube is a continuous tube from the first end to the second end.

25. A method of making a flattened tube heat exchanger, the method comprising the steps of:

providing a flattened tube having first and second ends with a length therebetween, opposite first and second heat transfer surfaces that extend from the first end to the second end, and at least one fluid passageway that extends through the tube from the first end to the second end;

providing at least one heat transfer fin having first and second ends;

attaching the at least one heat transfer fin to at least one of the first or second heat transfer surfaces so that the first end of the at least one heat transfer fin is conductively attached to the heat transfer surface and extends along a portion of the length of the tube;

attaching first and second manifolds to the respective first and second ends of the tube so that the first and second manifolds are in fluid communication with the at least one passageway and a fluid can pass between the first and second manifolds via the at least one passageway; and

shaping the flattened tube to a predetermined configuration.

26. The method of claim 25, wherein the step of shaping the flattened tube comprises:

shaping the flattened tube so that portions of the heat transfer surfaces are adjacent to other portions of the heat transfer surfaces, the adjacent portions of the heat transfer surfaces are spaced apart with a space existing between each of the adjacent portions of the heat transfer surfaces, and a portion of the second end of the at least one heat transfer fin extends into at least one of the spaces between adjacent portions of the heat transfer surfaces.

27. The method of claim 26, wherein the step of shaping the flatten tube further comprises:

shaping the flattened tube so that the portion of the second end of the at least one heat transfer fin extends into at least one of the spaces between adjacent portions of the heat transfer surfaces without contacting the adjacent portion of the heat transfer surface.

28. The method of claim 26, wherein the predetermined configuration is a coil and the step of shaping the flattened tube further comprises:

coiling the flattened tube along the length to form a coil with the first end in a central portion of the coil, the second end along a periphery of the coil, the first and second heat transfer surfaces radially opposite, and the adjacent portions of the heat transfer surfaces are radially adjacent.

29. The method of claim 28, wherein the step of shaping the flattened tube further comprises:

bending the flattened tube into alternating straight segments and curved segments to form the coil.

30. The method of claim 29, wherein:

the curved segments are 90 degree curves.

31. The method of claim 26, wherein:

the step of providing at least one heat transfer fin comprises providing a plurality of heat transfer fins; and

the step of attaching the at least one heat transfer fin comprises attaching the plurality of heat transfer fins so that the first end of at least one heat transfer fin of the plurality of heat transfer fins is conductively attached to the first heat transfer surface and the first end of a different at least one heat transfer fin of the plurality of heat transfer fins is conductively attached to the second heat transfer surface.

32. The method of claim 31, wherein the step of attaching the plurality of heat transfer fins further comprises:

attaching the at least one heat transfer fin of the plurality of heat transfer fins to the first heat transfer surface so that the at least one heat transfer fin extends along the entire length of the tube from the first end to the second end.

33. The method of claim 32, wherein the step of attaching the plurality of heat transfer fins further comprises:

attaching the different at least one heat transfer fin of the plurality of heat transfer fins to the second heat transfer surface so that the different at least one heat transfer fin extends along the entire length of the tube from the first end to the second end.

34. The method of claim 31, wherein the step of shaping the flattened tube further comprises:

shaping the flattened tube so that a portion of the second end of at least one heat transfer fin of the plurality of heat transfer fins extends into at least one of the spaces between adjacent portions of the heat transfer surfaces without contacting the adjacent portion of the heat transfer surface.

35. The method of claim 25, wherein:

the step of providing a flattened tube comprises providing a roll of continuous flattened tube;

the step of providing at least one heat transfer fin comprises providing a roll of a continuous corrugated heat transfer fin having first and second ends; and

the step of attaching the at least one heat transfer fin comprises attaching the first end of the continuous corrugated heat transfer fin to at least one of the first or second heat transfer surfaces.

36. The method of claim 35, further comprising the step of:

cutting the continuous flattened tube with the attached continuous corrugated heat transfer fin to a predetermined length prior to performing the step of attaching first and second manifolds.

37. The method of clam 25, wherein:

the step of providing a flattened tube comprises extruding the flattened tube;

the step of attaching the at least one heat transfer fin further comprises attaching the at least one heat transfer fin to at least one of the first or second heat transfer surfaces while the flattened tube is being extruded; and further comprising the step of:

cutting the extruded flatten tube with the attached at least one heat transfer fin to a predetermined length prior to performing the step of attaching first and second manifolds.